The Science Behind Sustainable Communities Strategies

Susan Handy

ARB Research Seminar
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ITS UCDAVIS INSTITUTE OF TRANSPORTATION STUDIES

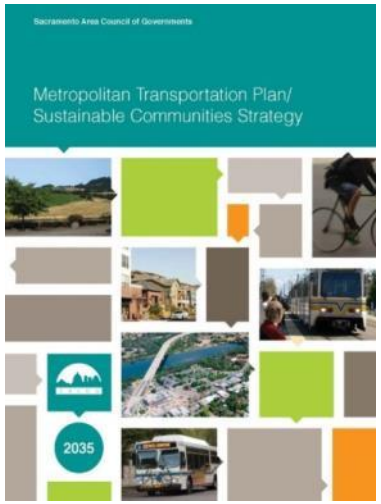
NC ST National Center for Sustainable Transportation

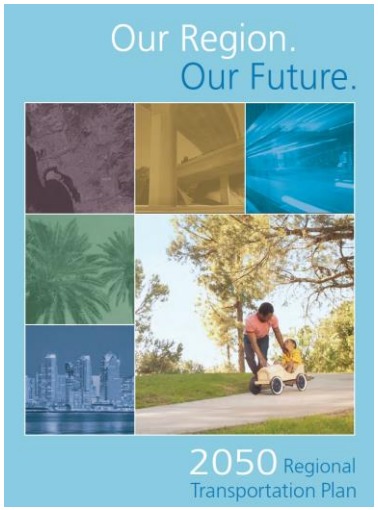
SB375
Sustainable Communities and Climate Protection Act of 2008

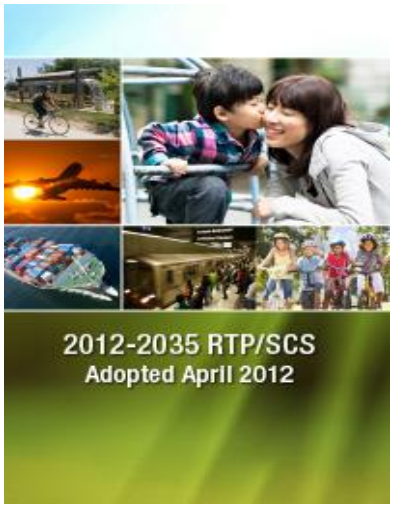
Targets for reducing per capita GHG emissions from cars and light trucks for metropolitan areas

Examples	2020	2035
Sacramento	-7%	-16%
Bay Area	-7%	-15%
LA region	-8%	-13%
San Diego	-7%	-13%

Sustainable Communities Strategies







How do we know what will work?

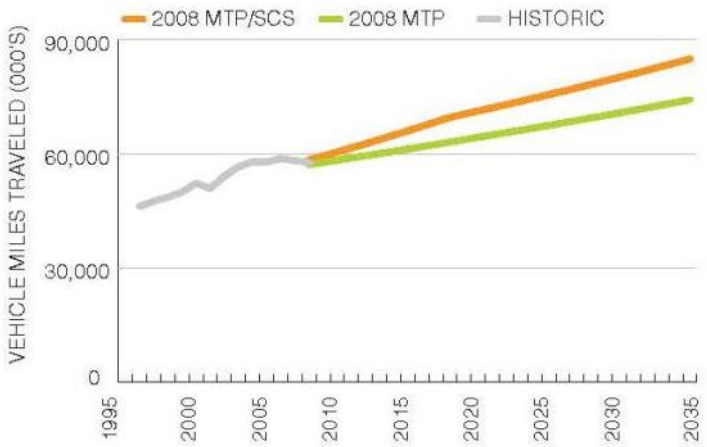
How do we know what combination of strategies will achieve the targets?



Regional Travel Demand Forecasting Models

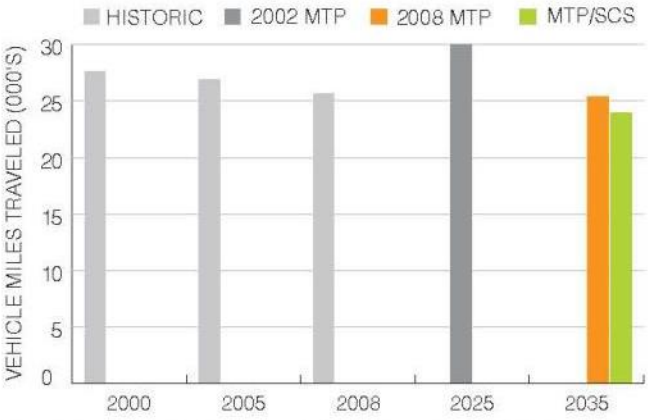
Example: SACOG's MTP/SCS 2035

Figure 5B.1
Total Vehicle Miles Traveled in the SACOG Region, Historic Trends and Projected MTP/SCS



Historic based on CPRD reports. MTP/SCS based on SACOG forecasts. 2008 MTP from SACOG, A Creative New Vision for Transportation in the Sacramento Region, April 2008.

Figure 5B.2
Weekday Vehicle Miles Traveled per Capita in the SACOG Region, Historic Trends and Projected MTP/SCS



Historic based on CPRD reports. MTP/SCS based on SACOG forecasts. 2008 MTP from SACOG, *A Creative New Vision for Transportation in the Sacramento Region*, April 2008. 2002 MTP from SACOG, *A Bold First Step for Mobility in the Sacramento Region*, 2002, with adjustments to allow for comparison to more current VMT estimates.

Results dependent on assumptions

Not all strategies can be analyzed

Impact of Transportation and Land-Use Related Policies on Passenger Vehicle Use and GHG Emissions

2010: 15 strategies

2012-14: updates plus 8 more strategies

Susan Handy, UC Davis, and Marlon Boarnet, USC

with Gil Tal, Kristin Lovejoy, Caroline Rodier, Giovanni Circella, and Steven Spears, Hsin-Ping Shu, David Weinreich

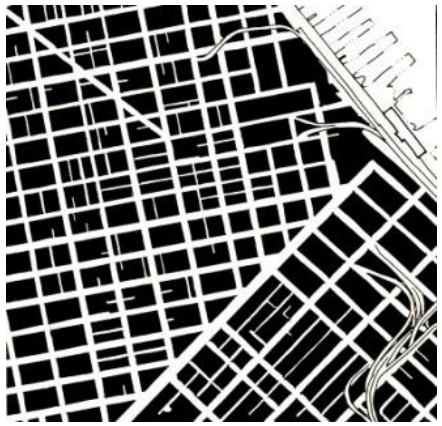
California Environmental Protection Agency

Air Resources Board

Strategies Reviewed -1

Land Use
- Residential Density
- Employment Density
- Land Use Mix
- Street Connectivity
- Regional Access to Employment
- Jobs-Housing Balance

Infrastructure and Services
- Distance to Transit
- Transit Service
- Car sharing
- Pedestrian infrastructure
- Bike infrastructure
- Roundabouts
- Highway Capacity



Strategies Reviewed - 2

Operations
- Eco-Driving
- Transportation Systems Management
- Traffic Incident Clearance Programs
- Fleet Turnover Incentives

Demand Management
- Telecommuting
- Employer-Based Trip Reduction
- Voluntary Travel Behavior Change Programs

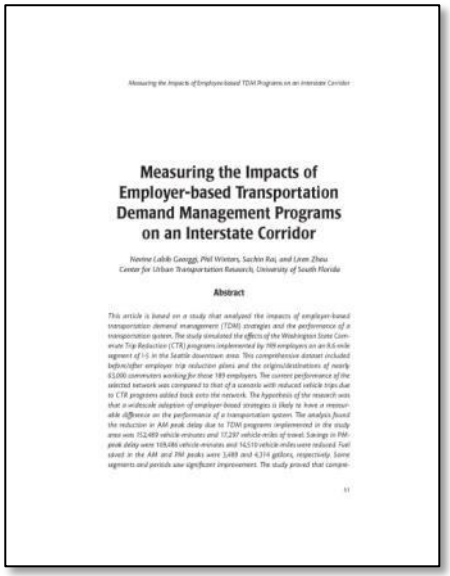
Pricing
- Gas Pricing
- Parking Pricing
- Road Pricing

Evidence from the peer-reviewed literature


Transportation Research Part D

Bike share's impact on car use: Evidence from the United States, Great Britain, and Australia

Elliot Fishman, Simon Washington, Narelle Haworth


Measuring the Impacts of Employer-based Transportation Demand Management Programs on an Interstate Corridor

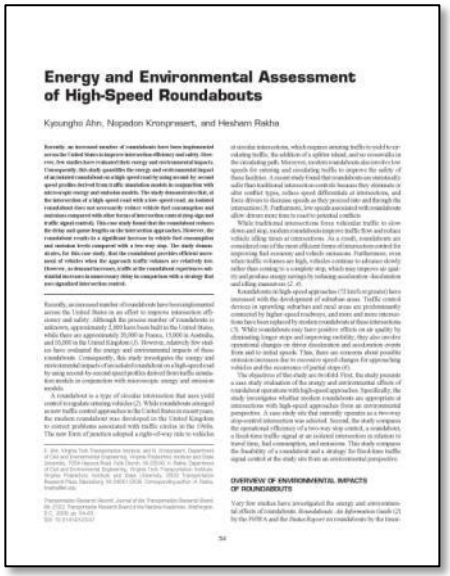
Nevine Labib Georggi, Phil Winters, Sachin Rai, and Liren Zhou
Center for Urban Transportation Research, University of South Florida

Abstract


Journal of Environmental Economics and Management

Green drivers or free riders? An analysis of tax rebates for hybrid vehicles

Amharish Chandra, Sumeet Gulati, Milind Kandlikar


Energy and Environmental Assessment of High-Speed Roundabouts

Kyoungho Ahn, Nopadon Kronprasert, and Hesham Rakha

Abstract

1. Introduction

OVERVIEW OF ENVIRONMENTAL IMPACTS OF ROUNDABOUTS

Some research reports included

Reliance on review papers when available

Criteria for Study Inclusion

Somewhat different by strategy but in general:

- Based on empirical data, not forecasting models; traffic simulation models used for some strategies
- Data from California; U.S. or international studies included if needed
- Controls for factors other than strategy that might affect outcomes, e.g. income, gas price
- Reports an effect size or enough information to calculate an effect size

Effect size = change in VMT per unit of strategy

Effect Sizes - 1

Strategy	Strategy Unit	% VMT Change
Land Use		
Residential Density	1% increase	-0.05 to -0.19%
Employment Density	1% increase	-0.03 to +0.07%
Land Use Mix	1% increase	-0.02 to -0.10%
Street Connectivity	1% increase	0.0 to -0.12%
Regional Accessibility	1% increase	-0.13 to -0.25%
Jobs-Housing Balance	1% improvement	-0.29 to -0.35%
Infrastructure and Services		
Distance to Transit	1 mile closer	-1.3 to -5.8%
Transit Service	1% improvement	n/a
Car Sharing	for participants	-27 to -33%
Pedestrian Infrastructure	1% increase	0.0 to -0.19%
Bicycle Infrastructure	1% increase	n/a
Roundabouts	vs. stop sign or signal	-59 to +25%*
Highway Capacity/Induced Travel	*1% increase*	*+0.3 to +1.0%*

***** Impact on fuel consumption and/or GHG emissions

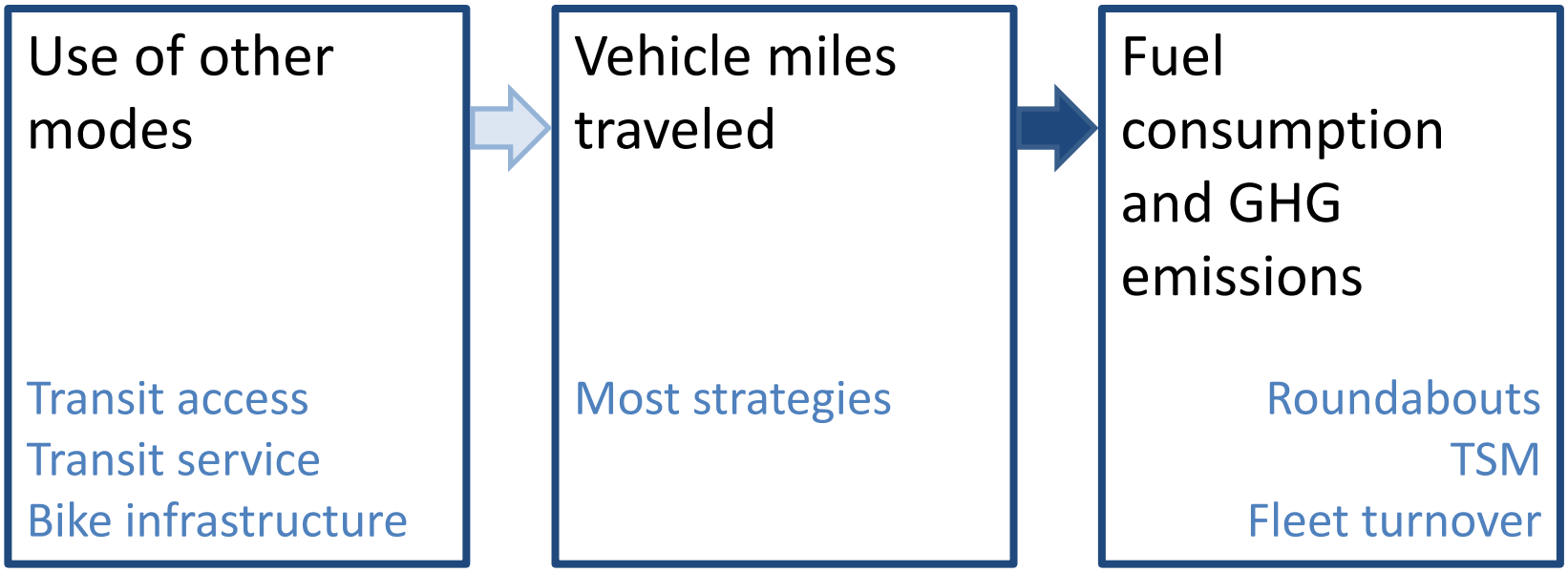
Effect Sizes - 2

Strategy	Strategy Unit	% VMT Change
Operations		
Eco-Driving	Program participants	-1 to -6%
Transportation Systems Mgmt	Where implemented	-0.1 to -8%*
Traffic Incident Clearance Programs	Where implemented	n/a
Fleet Turnover Incentives	$101 to $640 per ton of CO_2 reduced	
Demand Management		
Telecommuting	Program participants	-48 to -90%
Employer-Based Trip Reduction	firms > 100 employees	-1.1 to -6.0%
Voluntary Travel Behavior Change	Program participants	-5 to -12%
Pricing		
Gas Price	1% increase	-0.03 to -0.30%
Parking Pricing	$3.00/day at work	-1.9 to -2.6%
Road User Pricing	1% increase	n/a

***** Impact on fuel consumption and/or GHG emissions

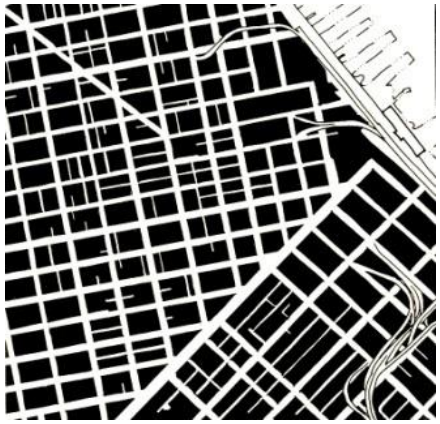
One thing to note

Different "outcomes" reported for different strategies



Increases in transit, walking, biking do not directly translate into VMT reductions

Reductions in fuel consumption and GHG emissions without VMT reductions



What do these numbers mean?

What do they say about what would happen if we could implement these strategies?

Proceed with caution…

What if…? Part 1

Land Use Strategy	% Change by 2035	% Change in VMT
Population density	1.5% increase	-0.18%
Employment density	1.5% increase	-0.08%
Land use mix	1.5% increase	-0.06%
Network Connectivity	1.5% increase	-0.09%
Regional accessibility	1.5% increase	-0.28%
Jobs/housing balance	1.5% improvement	-0.48%
Total Land Use Effect		***-1.17%***

Caution! This is a completely hypothetical exercise

What if…? Part 2

Infrastructure Strategy	% Change by 2035	% Change in VMT
Distance to Transit	2% in region a mile closer	-0.04%
Transit Service*	30% service up or fare down	-1.65%
Car Sharing	5% in region participate	-1.50%
Pedestrian Infrastructure	5% increase	-0.48%
Bicycle Infrastructure*	5% increase	-0.02%
Roundabouts**	5% of intersections	-0.06%
Highway Decrease***	1% decrease	-0.65%
Total Infrastructure Effect		***-4.40%***

*Assuming all increase in transit or bicycling replaces driving

**Fuel/GHG effect; assumes intersections account for 10% of total fuel consumption or GHG emissions

***Assuming capacity decrease has opposite effect of capacity increase

Caution! This is a completely hypothetical exercise

What if…? Part 3

Operations Strategy	% Change by 2035	% Change in VMT
Eco-Driving	5% participate	-0.18%
TSM	10% of roadways	-0.41%
Total Operations Effect		***-0.58%***

Demand Mgmt Strategy	% Change by 2035	% Change in VMT
Telecommuting*	5% participate	-1.04%
EBTR*	25% of workers	-0.27%
Behavior Change	5% participate	-0.43%
Total Demand Mgmt Effect		***-1.73%***

Pricing Strategy	% Change by 2035	% Change in VMT
Gas Price	10% increase	-1.65%
Parking Pricing*	10% pay $3.00 per day	-0.07%
Road User Pricing	= 10% gas price hike	-1.65%
Total Pricing Effect		***-3.37%***

*Assuming work VMT is 30% of all VMT in region

Caution! This is a completely hypothetical exercise

What if…? Summary

Category	Total Effects
Land Use	-1.2%
Infrastructure and Services	-4.4%
Operations	-0.6%
Demand Management	-1.7%
Pricing	-3.4%
Total Effects	***-11.2%***

Caution! This is a completely hypothetical exercise

Doesn't context matter?

Are the effects simply additive?

How realistic are these changes?

How certain are the estimated effect sizes?

Of course context matters

One outcome

Another outcome

Are the effects additive?

If strategies overlap, adding will over-estimate effects

If strategies complement, adding will under-estimate effects

How realistic are these changes?

We also need research on the effects of policies on built environment characteristics

We have lots of evidence on how the built environment affects travel behavior

How realistic are these changes?

We also need research on the effects of policies on program participation

We have at least some evidence on how the program participation affects travel behavior

How good is the evidence?

Strong	Moderate	Limited	Weak
Residential Density	Street Connectivity	Employment Density	Bicycle Infrastructure
Land Use Mix	Jobs-Housing Balance	Car Sharing	Roundabouts
Regional Accessibility	Distance to Transit	Ped Infrastructure	Road User Pricing
Highway Capacity	TSM	Parking Pricing	
Eco-Driving	EBTR Programs		
Telecommuting	Behavior Change		
Gas Price			

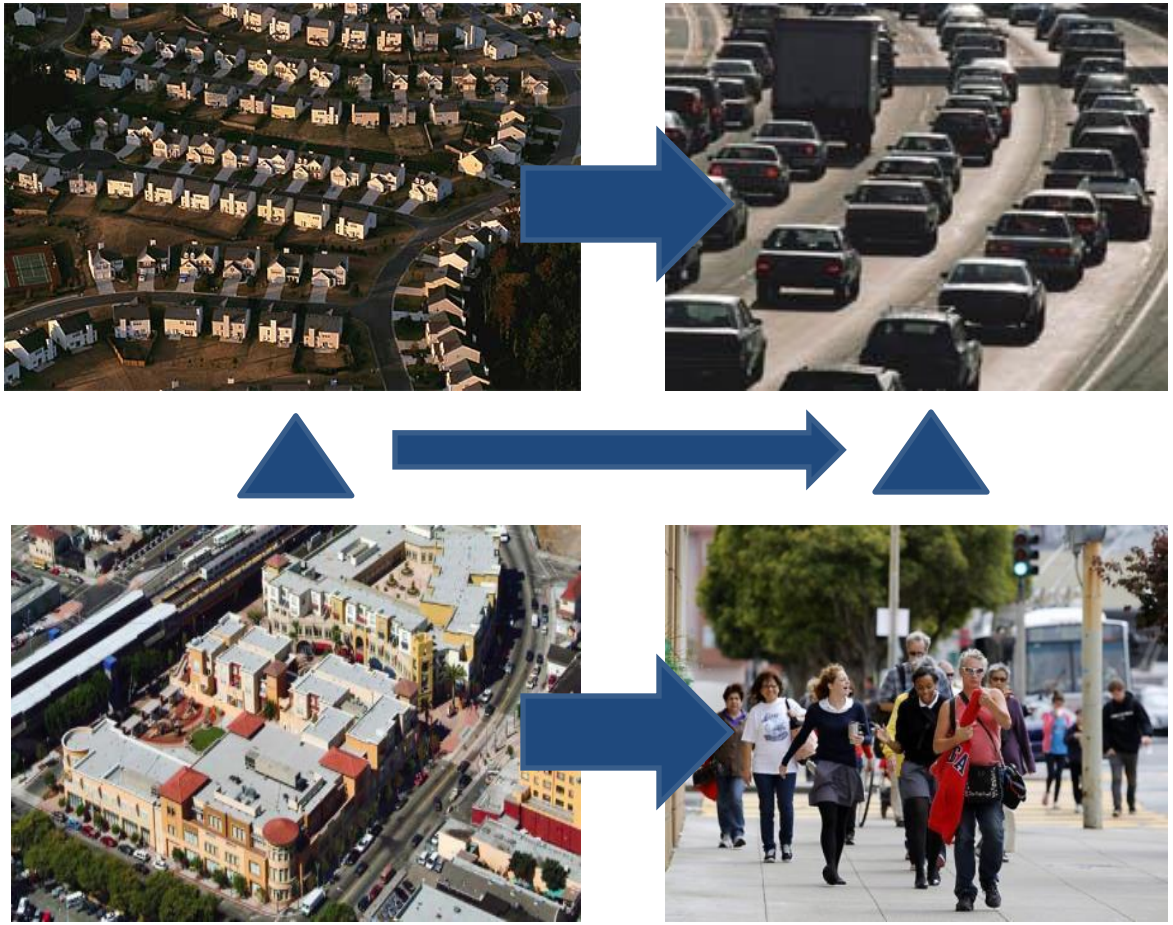
Two major problems:
Cross-sectional studies versus experiments
Pilot studies versus large-scale experiments

Cross-Sectional Studies

differences in land use associated with differences in travel

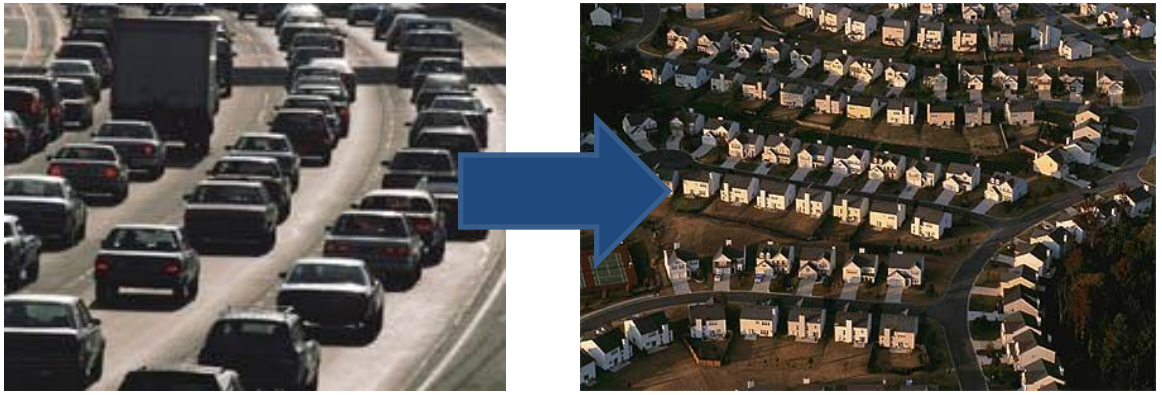
Causal Effect =

Changes in land use lead to changes in travel

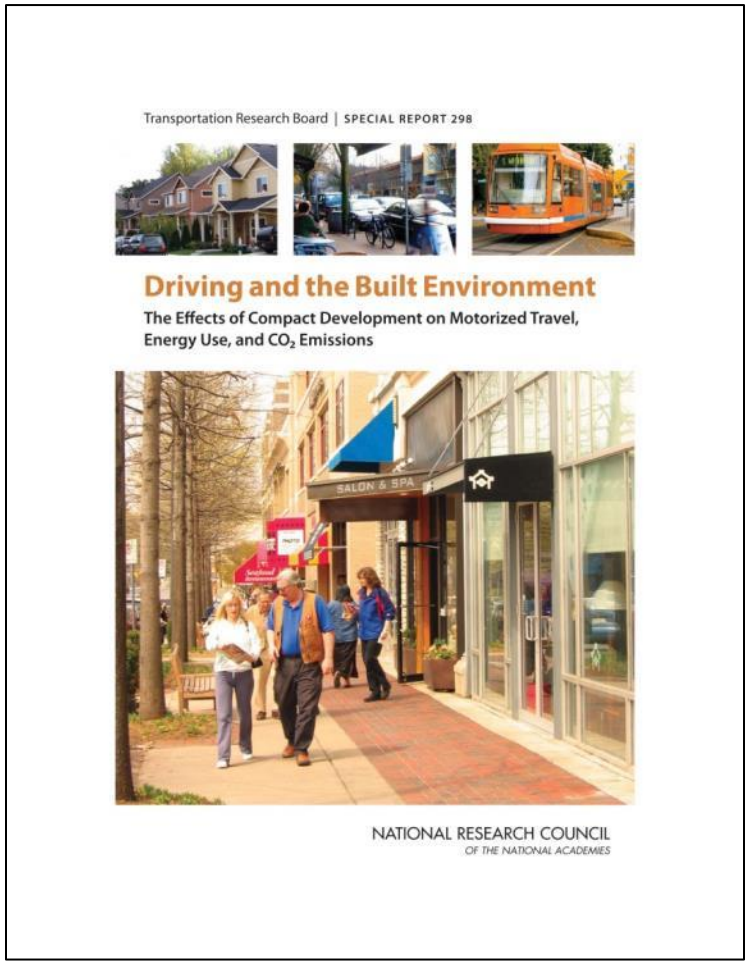


Self-Selection Effect =

Preferences for travel influence type of neighborhood chosen



TRB Special Report 298



"careful before-and-after studies of policy interventions to promote more compact, mixed-used development to help determine what works and what does not"

"Natural experiments"

"Intervention studies"

"Policy evaluation"

Natural experiments for programs

Telecommuting programs

Car sharing programs

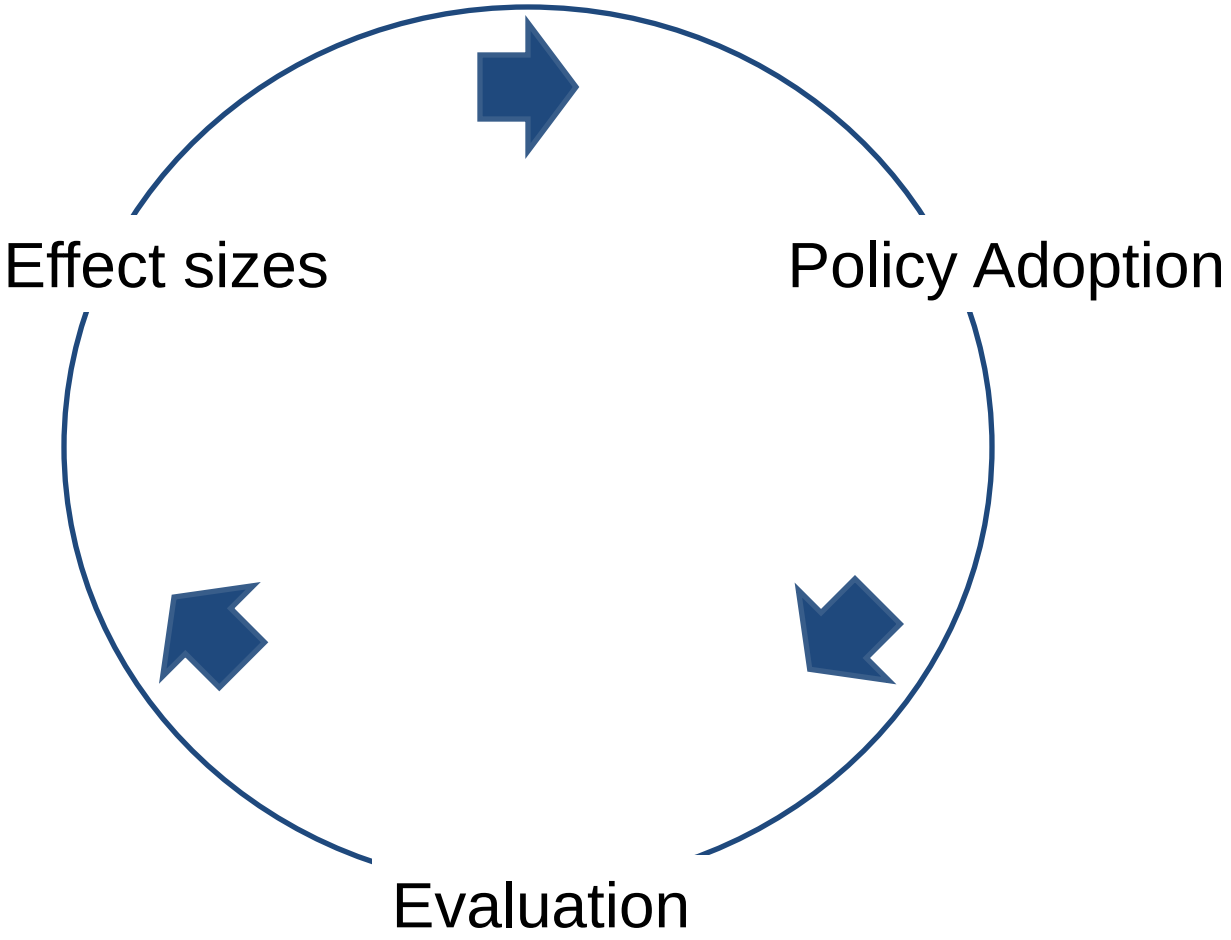
Employer-based trip reduction programs

Natural Experiments for Infrastructure

Green Lane Project
Portland State University
5 cities

Expo Line Opening
UC Irvine, USC
1 line

Building the Evidence Base



What we do know:
We need a multifaceted approach to VMT reduction



Step 1: Make it possible to drive less

Land-Use Mix

Connectivity

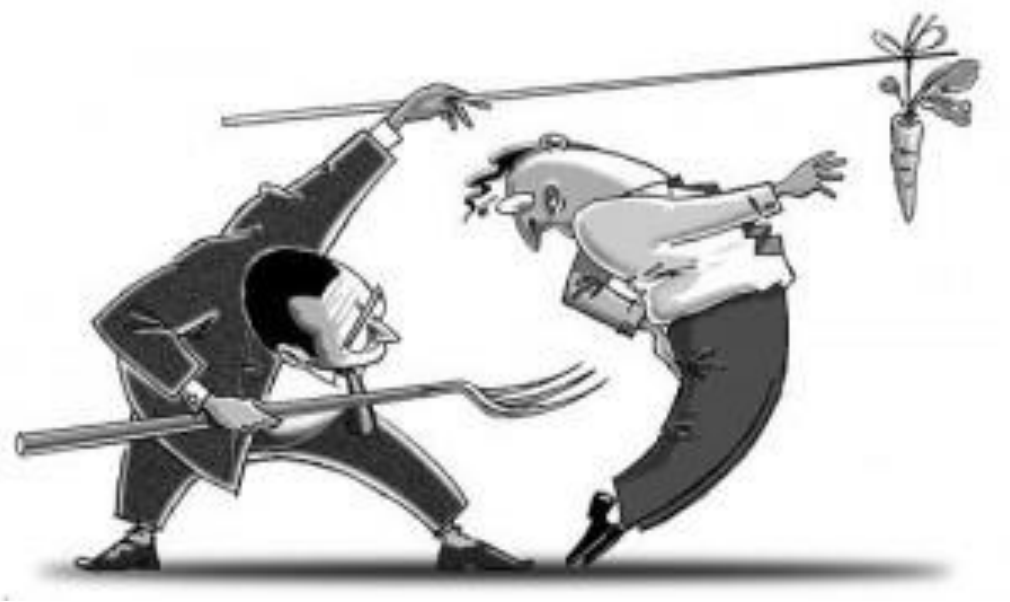
Transit, bike, ped

Step 2: Help people see how to drive less

Information

Education

Step 3: Make people want to drive less



The Stick: Make it harder to drive

Pricing

Capacity reductions

The Carrot: Make it cool to drive less

Hip design

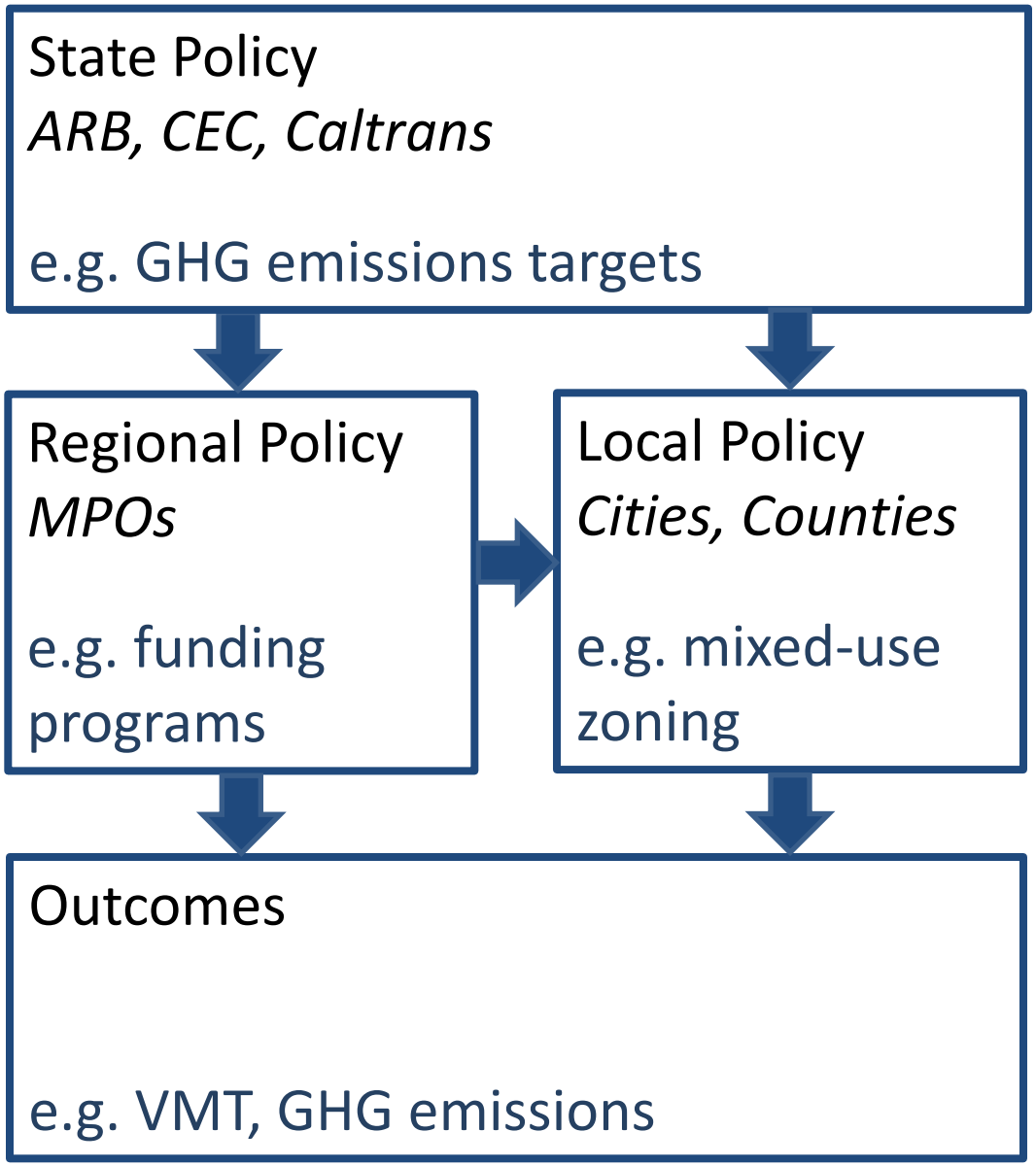
Social marketing

At the same time: Reduce the impact when people do drive

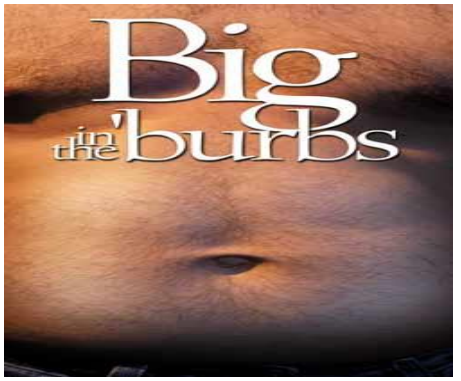
What we also know:
This will take action at all levels of government



Action at all levels of government



Countless Co-Benefits…



The National Center for Sustainable Transportation is advancing an environmentally sustainable transportation system through:

- **RESEARCH** – *Producing "state of knowledge" white papers and interdisciplinary research projects*
- **EDUCATION** – *Developing model curriculum for graduate programs and advanced training programs*
- **ENGAGEMENT** – *Informing the policy-making process at the local, state, and federal level*

RESEARCH FOCUS

Research will explore various modes, settings, scales, and sectors for people, services, and goods on the following themes:

Low-carbon Infrastructure And Efficient System Operation

Low-impact Travel And Sustainable Land Use

Zero-emission Vehicle And Fuel Technologies

Institutional Change

For more information

Susan Handy
slhandy@ucdavis.edu

Laura Podolsky
lpodolsky@ucdavis.edu

www.its.ucdavis.edu
www.ncst.ucdavis.edu

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